

IN THE CLAIMS:

1. (Cancelled)
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32. (Cancelled)

33. (Cancelled)

34. (New) A semiconductor device manufacturing method comprising the steps of:

generating a film forming gas by using any one of a silicon-contained organic compound having a siloxane bond and a silicon-contained organic compound having a  $\text{CH}_3$  group and in addition  $\text{H}_2\text{O}$ , setting a flow rate ratio of  $\text{H}_2\text{O}$  to the silicon-contained organic compound to 4 or more, and adjusting a gas pressure to 1.5 Torr or more;

applying a power to the film forming gas to generate a plasma thereof so as to react it, and thus forming a low-dielectric insulating film on a substrate;

generating a process gas containing at least any one of He, Ar,  $\text{H}_2$  and deuterium;

generating a plasma by applying a power to the process gas; and

bringing the low-dielectric insulating film into contact with the plasma of the

process gas.

35. (New) A semiconductor device manufacturing method according to claim 34, wherein the step of bringing the low-dielectric insulating film into contact with the plasma of the process gas is followed by the further step of:

removing a surface layer of the low-dielectric insulating film.

36. (New) A semiconductor device manufacturing method according to claim 35, wherein the step of removing the surface layer of the low-dielectric insulating film is followed by the further subsequent step of:

increasing a temperature of the low dielectric insulating film to 375 °C or more at an atmospheric pressure or a low pressure, and then bringing the low-dielectric insulating film into contact with a process gas having a  $\text{CH}_3$  group, while the low-dielectric insulating film is not brought into contact with an atmosphere.

37. (New) A semiconductor device manufacturing method according to claim 34, wherein  $\text{C}_x\text{H}_y$  (x, y are a positive integer),  $\text{C}_x\text{H}_y\text{F}_z$  or  $\text{C}_x\text{H}_y\text{B}_z$  (x, y are 0 (where, except the case  $x=y=0$ ) or a positive integer, z is a positive integer) is added to the film forming gas.

38. (New) A semiconductor device manufacturing method according to claim 34, wherein wirings or electrodes consisting mainly of a copper film are formed on the substrate.

39. (New) A semiconductor device manufacturing method comprising the steps of:  
generating a film forming gas by using any one of a silicon-contained organic compound having a siloxane bond and a silicon-contained organic compound having a  $\text{CH}_3$  group and in addition  $\text{H}_2\text{O}$ , setting a flow rate ratio of  $\text{H}_2\text{O}$  to the silicon-contained organic compound to 4 or more, and adjusting a gas pressure to 1.5 Torr or more;  
applying a power to the film forming gas to generate a plasma thereof so as to react it, and thus forming a low-dielectric insulating film on a substrate; and  
annealing the low-dielectric insulating film in an atmosphere of a nitrogen gas or an inert gas at a temperature of 400 °C or more.

40. (New) A semiconductor device manufacturing method according to claim 39, wherein the step of annealing the low-dielectric insulating film is followed by the further step of:

removing a surface layer of the low-dielectric insulating film.

41. (New) A semiconductor device manufacturing method according to claim 40, wherein the step of removing the surface layer of the low-dielectric insulating film is followed without bringing the low-dielectric insulating film into contact with an atmosphere by the further subsequent step of:

increasing a temperature of the low-dielectric insulating film to 375 °C or more at an atmospheric pressure or a low pressure, and then bringing the low-dielectric insulating film into contact with a process gas having a  $\text{CH}_3$  group.

42. (New) A semiconductor device manufacturing method according to claim 34, wherein  $C_xH_y$  ( $x, y$  are a positive integer),  $C_xH_yF_z$  or  $C_xH_yB_z$  ( $x, y$  are 0 (where, except the case  $x=y=0$ ) or a positive integer,  $z$  is a positive integer) is added to the film forming gas.

43. (New) A semiconductor device manufacturing method according to claim 34, wherein wirings or electrodes consisting mainly of a copper film are formed on the substrate.

44. (New) A semiconductor device manufacturing method comprising the steps of:

generating a film forming gas by using any one of a silicon-contained organic compound having a siloxane bond and a silicon-contained organic compound having a  $CH_3$  group and in addition  $H_2O$ , and setting a flow rate ratio of  $H_2O$  to the silicon-contained organic compound to 12 or more;

increasing a temperature of a substrate up to  $200\text{ }^{\circ}\text{C}$  or more but  $400\text{ }^{\circ}\text{C}$  or less;

and

applying a power to the film forming gas to generate a plasma thereof so as to react it, and thus forming a barrier insulating film on the substrate whose temperature is raised.

45. (New) A semiconductor device manufacturing method according to claim 44, wherein, in the step of generating the film forming gas, a pressure of the film forming

gas is adjusted to below 1.0 Torr and, in the step of forming the barrier insulating film, a power of a frequency of below 1 MHz is applied to the substrate to bias the substrate and to generate a plasma of the film forming gas by the power of the frequency of below 1 MHz so as to react it, and thus the barrier insulating film is formed.

46. (New) A semiconductor device manufacturing method according to claim 44, wherein, in the step of generating the film forming gas, a pressure of the film forming gas is adjusted to below 1.0 Torr and, in the step of forming the barrier insulating film, a power of a frequency of below 1 MHz is applied to the substrate to bias the substrate while at least the power of the frequency of 1 MHz or more out of the power of the frequency of below 1 MHz or the power of the frequency of 1 MHz or more is applied to the film forming gas, whose pressure is adjusted to 1.0 Torr or more, to generate a plasma thereof so as to react it, and thus the barrier insulating film is formed.

47. (New) A semiconductor device manufacturing method according to claim 44, wherein dinitrogen monoxide ( $\text{N}_2\text{O}$ ) is added, or nitrogen ( $\text{N}_2$ ) or ammonia ( $\text{NH}_3$ ) is added, or dinitrogen monoxide ( $\text{N}_2\text{O}$ ) and ammonia ( $\text{NH}_3$ ) are added to the film forming gas.

48. (New) A semiconductor device manufacturing method according to claim 44, wherein  $\text{C}_x\text{H}_y$  ( $x, y$  are a positive integer),  $\text{C}_x\text{H}_y\text{F}_z$  or  $\text{C}_x\text{H}_y\text{B}_z$  ( $x, y$  are 0 (where, except the case  $x=y=0$ ) or a positive integer,  $z$  is a positive integer) is added to the film forming gas.

49. A semiconductor device manufacturing method according to claim 44, wherein wirings or electrodes consisting mainly of a copper film are formed on the substrate.

50. A semiconductor device manufacturing method comprising the steps of:

generating a film forming gas by using any one of a silicon-contained organic compound having a siloxane bond and a silicon-contained organic compound having a  $\text{CH}_3$  group and  $\text{H}_2\text{O}$ , and setting a flow rate ratio of  $\text{H}_2\text{O}$  to the silicon-contained organic compound to 12 or more;

adjusting a pressure of the film forming gas to below 1.0 Torr;

increasing a temperature of a substrate up to 200 °C or more but 400 °C or less;

applying a power of a frequency of below 1 MHz to the substrate to bias the substrate and to generate a plasma of the film forming gas by the power of the frequency of below 1 MHz so as to react the plasma, and thus forming a first insulating film;

generating the film forming gas;

adjusting a pressure of the film forming gas to 1.0 Torr or more;

increasing a temperature of a substrate up to 200 °C or more but 400 °C or less;

and

applying a power of a frequency of below 1 MHz to the substrate to bias the substrate while applying at least the power of the frequency of 1 MHz or more out of the power of the frequency of below 1 MHz or the power of the frequency of 1 MHz or more to the film forming gas, whose pressure is adjusted to 1.0 Torr or more, to generate a

plasma thereof so as to react it, and thus forming a second insulating film on the first insulating film, whereby the barrier insulating film composed of the first insulating film and the second insulating film is formed.

51. (New) A semiconductor device manufacturing method according to claim 50, wherein dinitrogen monoxide ( $\text{N}_2\text{O}$ ) is added, or nitrogen ( $\text{N}_2$ ) or ammonia ( $\text{NH}_3$ ) is added, or dinitrogen monoxide ( $\text{N}_2\text{O}$ ) and ammonia ( $\text{NH}_3$ ) are added to the film forming gas.

52. (New) A semiconductor device manufacturing method according to claim 50, wherein  $\text{C}_x\text{H}_y$  ( $x, y$  are a positive integer),  $\text{C}_x\text{H}_y\text{F}_z$  or  $\text{C}_x\text{H}_y\text{B}_z$  ( $x, y$  are 0 (where, except the case  $x=y=0$ ) or a positive integer,  $z$  is a positive integer) is added to the film forming gas.

53. (New) A semiconductor device manufacturing method according to claim 50, wherein wirings or electrodes consisting mainly of a copper film are formed on the substrate.